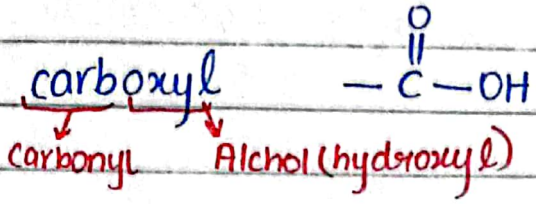
CHAPTER : 013

CARBOXYLIC ACID

Q What are carboxylic acids ?

"class of organic compounds which contain carboxyl group (-COOH) as a functional group."



TYPES

Aliphatic **Aromatic**

Mono **Di-COOH** **Mono** **Di-COOH**

→ formica (ant)
$HCOOH$ (formic)
CH_3COOH (Acetic) (Vinegar 5%)
CH_3CH_2COOH (propeonic)
$CH_3CH_2CH_2COOH$ (butyric)
↳ butter
$CH_3(CH_2)_3COOH$ (Pentanoic)
(Valaric acid)

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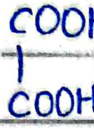
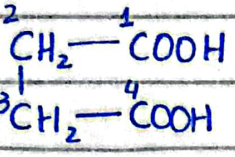
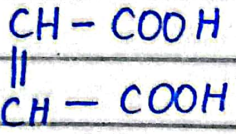
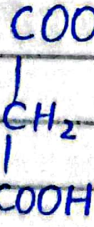
IUPAC NAMING

Methan(e) →
Methanoic acid

FORMULA	Common	IUPAC
	oxalic acid	ethanedioc acid
	Succinic acid	1,4 butanedioc acid
	Maliec acid	1,4-butenedioc acid
	Maloni c	1,3-Propanedioc acid

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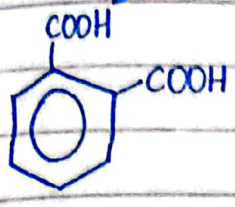
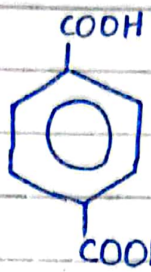
hydration ... dehydration)

Dicarboxylicaromatic compounds:



1,2-Benzenedioxacid
(Phthalic acid)



1,4-Benzendiocacid
(ter Phthalic acid)

PREPARATIONS

i) FROM ALCOHOLS

$$CH_3CH_2-OH + [O] \xrightarrow[H_2SO_4]{KMnO_4} CH_3-\overset{O}{\overset{\|}{C}}-H + H_2O$$

$$CH_3-\overset{O}{\overset{\|}{C}}-H + [O] \xrightarrow[H_2SO_4]{KMnO_4} CH_3-\overset{O}{\overset{\|}{C}}-OH$$

ii) FROM ALDEHYDES

$$CH_3-\overset{O}{\overset{\|}{C}}-H + [O] \xrightarrow[H_2SO_4]{KMnO_4} CH_3-\overset{O}{\overset{\|}{C}}-OH$$

iii) HYDRATION OF NITRILES HYDROLYSIS

* exp

- CH_3-CN

Methyl cyanide

Ethane nitrile (IUPAC)

↳ Total no. of carbons

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$CH_3-CN + H_2O \longrightarrow CH_3COOH + NH_3$

- -CN always produce carboxylic acid on hydrolysis
- product always remain same either we use acid or base
- But byproduct of acid hydrolysed is NH_4^+ and that of base hydrolysed is NH_3.

$$CH_3-CN + H_2O \xrightarrow{H^+} CH_3COOH + NH_4^+$$

$$CH_3-CN + H_2O \xrightarrow{\bar{O}H} CH_3COOH + \ddot{N}H_3$$

iv) FROM GRIGNARD REAGENT

$$R-X + Mg \longrightarrow R-\overset{+\delta}{Mg}-\overset{-\delta}{X}$$

- Most imp and most reactive reagent.
- Almost every class of organic compound can be synthesized by

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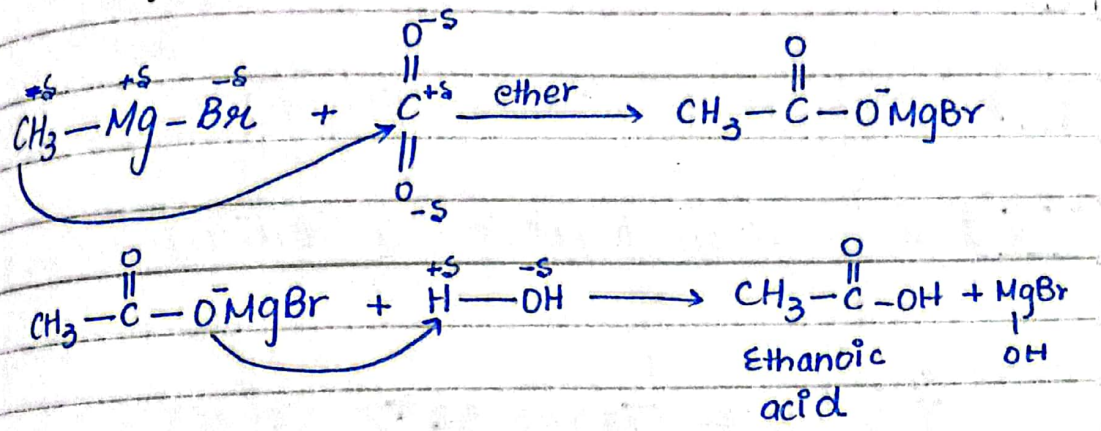
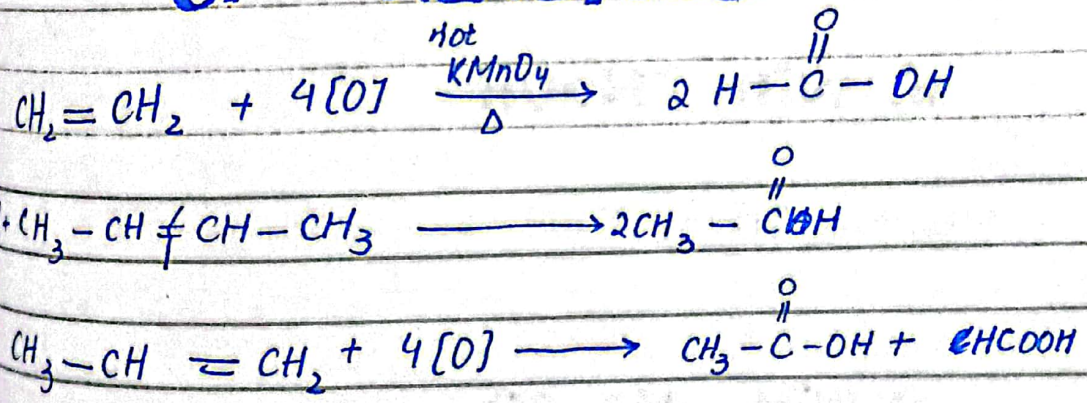
grignard reagent.

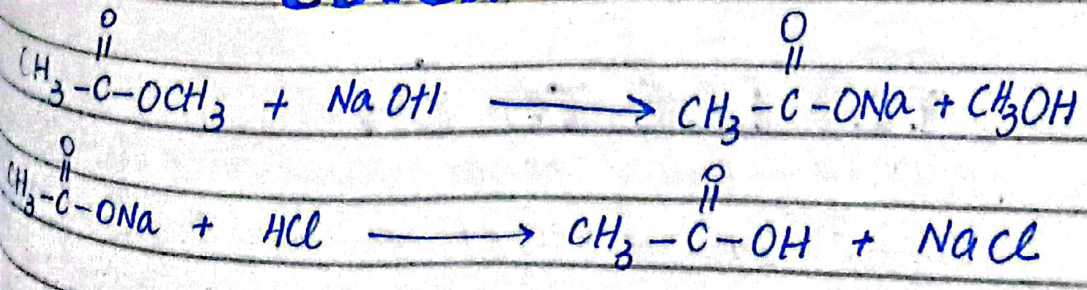
Victor Grignard in 1900.



V) OXIDATIVE CLEAVAGE OF ALKENES



VI) HYDROLYSIS OF ESTERS



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REACTIONS OF $-\overset{O}{\overset{\|}{C}}-OH$

i) $-H^+$ (Electrophillic substitution)

ii) $-\bar{O}H$ (Nucleophilic substitution)

iii) $R-\overset{O}{\overset{\|}{C}}-OH$ (Nucleophillic substitution)

i) DUE TO H^+

a) with Na^+ METAL

$$CH_3-\overset{O}{\overset{\|}{C}}-OH + Na \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-ONa + \frac{1}{2}H_2$$

b) With NaOH

$$CH_3-\overset{O}{\overset{\|}{C}}-OH + NaOH \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-ONa + H_2O$$

c) With Na_2CO_3

$$CH_3-\overset{O}{\overset{\|}{C}}-OH + Na_2CO_3 \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-ONa + CO_2 + H_2$$

ii) DUE TO $\bar{O}H$

(Nucleophillic substitution)

$$CH_3-\overset{O}{\overset{\|}{C}}-OH + SOCl_2 \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-Cl + SO_2 + HCl$$

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when alcohol act as nucleophile, it removes H^+ of
- Carboxylic acid is end product of reactions of carbo organic compounds.

b) WITH PCl_5

$$CH_3-\overset{\overset{O}{\|}}{C}-OH + PCl_5 \longrightarrow CH_3-\overset{\overset{O}{\|}}{C}-Cl + HCl + POCl_3$$

Acetylchloride

c) with PCl_3

$$3CH_3-\overset{\overset{O}{\|}}{C}-OH + PCl_3 \longrightarrow 3CH_3-\overset{\overset{O}{\|}}{C}-Cl + H_3PO_3$$

Acetylchloride

iii) DUE TO $R-\overset{\overset{O}{\|}}{C}-OH$

(Nucleophillic substitution)

d) ESTERIFICATION

(Nucleophillic subtitution)

- Formation of ester

$$CH_3-\overset{\overset{O}{\|}}{C}-\boxed{OH} + C_2H_5\boxed{OH} \xrightarrow{H^+} CH_3-\overset{\overset{O}{\|}}{C}-O-C_2H_5 + H_2O$$

$C_2H_5O^-$ — Ethyl methylacetate

- Not a neutralization reaction but it is nucleophillic substitution
- Carboxylic group never attacks on any other but provides attacking site.
- H from alcohol and OH from carboxylic acid is removed
- Homogenous catalysis (same physical state of reactant, catalyst and product.)

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FORMATION OF ACID AMIDE

(Nucleophillic substitution)

i) $CH_3-\overset{\overset{O}{\|}}{C}-OH + NH_3 \longrightarrow CH_3-\overset{\overset{O}{\|}}{C}-\overset{+}{O}NH_4$

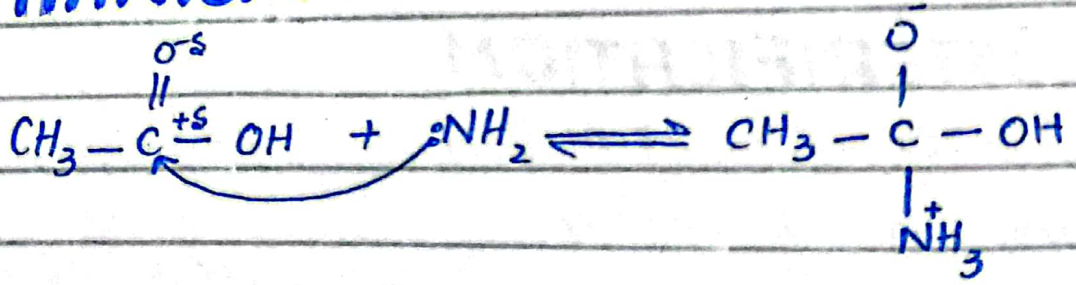
Stable

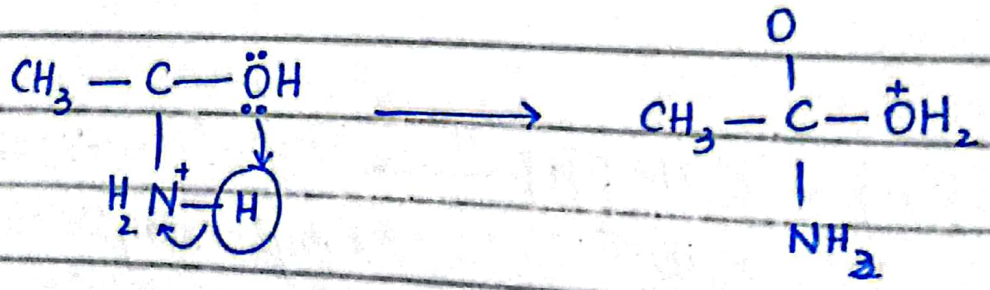
ii) $CH_3-\overset{\overset{O}{\|}}{C}-\overset{+}{O}NH_4 \xrightarrow{Heat} CH_3-\overset{\overset{O}{\|}}{C}-NH_2 + H_2O$

Acid amide

Acid amide is not formed directly bcz intermediate is stable.

MECHANISM:





REDUCTION

i) PARTIAL

Always primary alcohol is formed

$$CH_3-\overset{O}{\overset{\|}{C}}-OH + 4[H] \xrightarrow{LiAlH_4} CH_3-CH_2-OH + H_2O$$

ii) COMPLETE

Alkanes are formed

$$CH_3-\overset{O}{\overset{\|}{C}}-OH + 6HI \xrightarrow{R\cdot P} CH_3-CH_3 + H_2O + 3I_2$$

Ethanoic acid → Ethane

FORMATION OF ACID ANHYDR-IDE

$$R'-\overset{O}{\overset{\|}{C}}-OH + HO-\overset{O}{\overset{\|}{C}}-R \xrightarrow{P_2O_5} R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R + H_2O$$

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